ROYAL ASTRONOMICAL SOCIETY.

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At a Special General Meeting of the Society, called in pursuance of a Resolution of the Council on the 20th of September last,

G. B. Airy, Esq., President, in the Chair,

Sir J. F. W. Herschel read the following Memoir:—

In the performance of the melancholy duty imposed on me by the wishes of the Council, that I should endeavour, on this occasion, to place before the assembled Members of this Society a sketch of the scientific life and character of our late lamented President, I have been careful both to examine my own competency to the task, and to consider well the proper limits within which to confine myself in its execution. In the first of these respects, indeed, though tolerably familiar with some of the leading subjects which I shall have to touch upon, there are others on which I have seriously felt the want of a longer interval for preparation. On these, of course, I shall take care to express myself with becoming diffidence; and in so vast a field of laborious inquiry and of minute, yet important research as I shall have to range over, it may easily be supposed I have more than once found occasion to wish that the duty had fallen into abler hands. A duty, however, it is, and a very sacred one, which we owe to departed merit, to society, and to ourselves, to fix as speedily as possible, while its impress is yet fresh and vivid upon us, its features in our minds with all attainable distinctness and precision, and to store them up beyond the reach of change and the treachery of passing years.

As respects the limits within which I feel it necessary to confine myself on this occasion, it is to astronomers to whom I have to speak of an astronomer—to members of a large and, in the simplicity of truth I may add, a highly efficient public body—of an officer to whom more than to any other individual, living or dead, it owes the respect of Europe. To make what I have to say complete as a biography, however interesting to us all, however

desirable in itself, is very far either from my intention or my power. Nor is the time fitting for the attempt. The event is too recent, the particulars which can be collected at the present moment too scanty, the grief of surviving relations too fresh, to admit of that sort of close and pertinacious inquiry into facts, anecdotes, documents, and evidence, which personal biography requires to be satisfactory. In this respect, therefore, a mere sketch is all that I can pretend to give.

Francis Baily was born on the 28th of April, 1774, at Newbury, in the county of Berks. His father was Mr. Richard Baily, a native of Thatcham, in the same county, who became established as a banker at Newbury. He married Miss Sarah Head, by whom he had five sons and two daughters. Francis, who was the third son, received his education at the school of the Rev. Mr. Best, of Newbury, an establishment of considerable local reputation, where, although probably little of an abstract or mathematical nature was imparted, the chief elements of a liberal and classical education were undoubtedly communicated. From his early youth, he manifested a propensity to physical inquiry, being fond of chemical, and especially of electrical experiments,—a propensity sufficiently marked (in conjunction with his generally studious habits) to procure for him, among his young contemporaries, the half-jesting, half-serious *soubriquet* of "the Philosopher of Newbury."

It does not appear that he received any further instruction beyond the usual routine of an establishment of the kind above mentioned, so that, in respect of the sciences, and especially of that in which he attained such eminent distinction, he must be regarded as self-educated. This taste for and knowledge of electricity and chemistry were probably acquired from Dr. Priestley, with whom, at the age of seventeen, he became intimately acquainted, and of whom he always continued a warm admirer. But that his acquaintance with the subject was considerable, and his attachment to it permanent, may be concluded from the fact, that Mr. Welsh, the organist of the parish church of Newbury, who had a very pretty electrical apparatus, and at whose house I remember myself to have first witnessed an electrical experiment, is stated to have imbibed his taste for that science, and to have acquired its principles, from his example and instructions at a somewhat subsequent period.

He quitted Mr. Best's school at fourteen years of age, and, having chosen a mercantile life, which accorded with the views of his parents, he was sent to London, and placed in a house of business in the City, where he remained till his twenty-second year, when, having duly served his time, and either not feeling an inclination to the particular line of business in which he had commenced his life, or being desirous of the general enlargement of mind which travel gives, or from mere youthful love of adventure and enterprise, he embarked for America on the 21st October, 1795, which, however, he was not destined to reach without twice incurring the most imminent danger from shipwreck, both on our

own coast, under most awful circumstances, on the Goodwin Sands, and off New York, which he was prevented from reaching, being driven to sea in a gale, and, after endeavouring in vain to reach Bermuda, was driven into Antigua, whence he subsequently embarked for Norfolk, in Virginia.

In America, he remained one or two years, travelling over the whole of the United States and through much of the western country; in which travel he experienced, at various times, much hardship and privation, having, as I remember to have heard him state in conversation (and which must have referred to this period of his life), passed eleven months without the shelter of a civilized roof. During his residence in America, he was not unmindful of his intellectual and social improvement, having not only read much and observed much, as a copious journal which he transmitted home proves, but formed the acquaintance of some eminent persons, among whom may be mentioned Mr. Ellicot, the Surveyor-General of the United States, from whom he obtained some curious information bearing on the periodical displays of meteors on the 12th November, of which that gentleman observed a superb instance in 1799, and from whom it is not impossible he may have acquired a taste for observations of a more distinctly astronomical and geographical nature.

Whatever may have been the more direct object of this journey, if indeed it had any other than to gratify a youthful inclination for travel and adventure, it does not appear to have exercised any material influence on his after-life, since, on his return to England, in place of immediately entering into business, he continued to reside for some time with his parents at Newbury, which, however, at length he quitted for London, to engage in business as a stock-broker, being taken into partnership by Mr. Whitmore of the Stock Exchange. The exact date of this partnership I have not been able to learn. I believe it to have been 1801; but that it must have been prior to 1802, may be concluded from the subject of his first publication, which appeared in that year, viz. *Tables for the Purchasing and Renewing of Leases for Terms of Years certain and for Lives, with Rules for determining the Value of the Reversions of Estates after any such Leases.* This work (as well as the next) is preceded by a highly practical and useful Introduction, and followed by an Appendix, which shews, that at the age of twenty-eight he had become well versed in the works of the English mathematicians, and had also consulted those of foreign ones. It speedily attained a standard reputation on account of its intrinsic utility, and went through several editions. His next work, a pamphlet in defence of the rights of the Stock-Brokers against the attacks of the City of London, printed in 1806, at all events shews him at that time to have become identified in his feelings and interests with that body of which he lived to be an eminent and successful member. A similar conclusion may be drawn from his next publication, which appeared in 1808, *The Doctrine of Interest and Annuities Analytically Investigated and Explained,* a work than which no

one more complete had been previously published, and which is still regarded as the most extensive and standard work on compound interest. It was speedily followed by other works on the same subject, viz. in 1810, by *The Doctrine of Life Annuities and Insurances Analytically Investigated and Explained ;* to which, in 1813, he added an Appendix. This is a work in many ways remarkable, and its peculiarities are of a highly characteristic nature ; method, symmetry, and lucid order being brought in aid of practical utility in a subject which had never before been so treated, and old routine being boldly questioned and confronted with enlarged experience. A friend of great mathematical attainments and extensive practical acquaintance with subjects of this nature, thus characterizes it :—" It is not easy to say too much of the value of this work in promoting sound practical knowledge of the subject. It was the first work in which the whole of the subject was systematically algebraized ; the first in which modern symmetry of notation was introduced ; and the first modern work, since Price and Morgan, in which the *Northampton Tables* were not exclusively employed, and in which the longer duration of human life was contended for ; and the first in which some attempt was made to represent by symbols the various cases of annuities and assurances, afterwards more systematically done by Mr. Milne." In the Appendix to this work, a method originally proposed by Mr. Barrett of forming the tables, by which cases of temporary and deferred annuities, formerly requiring tedious calculations, become as easy as the others, and which, in the improved form subsequently given to it by Mr. Griffith Davies, has come into very general use in this country, was, by the penetration of Mr. Baily, given to the public, but for which it would probably have been altogether lost. It may serve to give some idea of the estimation in which this work was held, that when out of print, its copies used to sell for four or five times their original price. A chapter of this work is devoted to the practical working of the several life assurance companies in London, containing some free remarks on several points of their practice. Mr. Babbage has subsequently followed in the same line (as he has also advocated extending the estimation of the duration of life to still more advanced ages). However unpleasing it may be to public bodies, especially commercial ones, to see practices of whose injustice they may perhaps have been unaware, convicted of it, and made matter of public animadversion, there can be no doubt that criticisms of this kind, when really well grounded and expressed with temperance and moderation, are both salutary to the parties concerned, and merit, in a high degree, the gratitude of the public. A higher praise is due to the candour and boldness of openly entering the lists on such occasions, and despising the anonymous shield of which so many avail themselves.

But while devoting his attention thus assiduously to matters of direct commercial interest, he could yet find time for other objects of a more general nature. Astronomical pursuits had already begun to assume in his eyes that attraction, which was destined ultimately to

draw him aside entirely from business, and to constitute at once the main occupation and the chief delight of his life. As every thing to which he turned his thoughts presented itself to them, if I may use the expression, in the form of a palpable reality, a thing to be turned and examined on all sides—to be reduced to number, weight, and measure—to be contemplated with steadiness and distinctness, till every thing shadowy and uncertain had disappeared from it, and it had moulded itself, under his scrutiny, into entire self-consistency, the practical branches of astronomical calculation early became, in his hands, instruments of the readiest and most familiar application, as the touchstones of the truth of its theories and the means of giving to them that substantial reality which his mind seemed to crave as a condition for their distinct conception by it. His first astronomical paper, on the celebrated solar eclipse, said to have been predicted by Thales, which was written in November 1810, and read before the Royal Society on the 14th March, 1811, affords a remarkable instance of this. That eclipse had long been a disputed point among chronologists. It was easy to perceive, and accordingly all had perceived, that an eclipse of the sun, so nearly central as to produce great darkness, being a rare phænomenon in any part of the globe, and excessively so in any precisely fixed locality, must afford a perfectly certain means of determining the date of a coincident event, if only the geographical locality be well ascertained, and some moderate limits of time within which the event must have happened be assigned, and provided the means were afforded of calculating back the moon's place for any remote epoch. In this case, both the locality and the probable historical limits were sufficiently precise; and the account of Herodotus, which agrees only with the character of a total and not of an annular eclipse (as Mr. Baily was the first to remark) still further limits the problem. But the tables of the moon employed by all prior computists were inadequate to carry back her place with the requisite exactness, nor was it till the publication of Burg's *Lunar Tables* that the means of doing so were in the hands of astronomers. The course of Mr. Baily's reading at this period (being then, no doubt, employed in collecting the materials for the Chronological Tables in his *Epitome of Universal History*, which appeared not long after) brought him necessarily into contact with this subject. He perceived at once both the uncertainty of all former calculations of this eclipse, and the possibility of attacking it with a fresh prospect of success. None, however, but a consummate astronomical calculator would have ventured on such an inquiry, which involved the computation of all the solar eclipses during a period of seventy years, six centuries before the Christian era. These calculations led him to assign, as the eclipse in question, that of September 30, B.C. 610, which was central and total, according to these tables, at the very point where all historical probability places the scene of action.

Most men would have regarded such a result, obtained by so much labour, with triumphant complacency: not so Mr. Baily.

His habit of examining things on all sides, instead of permitting him to rest content with his conclusion, led him on to further inquiry, and induced him to calculate the phænomena of another total eclipse recorded in ancient history, that of Agathocles, which happened August 15, B.C. 310, an eclipse of which neither the date nor the locality admits of any considerable uncertainty, and which, therefore, appeared to him well fitted to test the accuracy of the tables themselves. Executing the calculation, he found indeed a total eclipse on the year and day in question, and passing near to the spot, *but not over it*. An irreconcilable gap of about 3°, or 180 geographical miles, remains between the most northerly limit of the total shadow, and the most southerly supposable place of Agathocles's fleet. Although this may justly be looked upon as a wonderful approximation between theory and historical fact (indicating, as it does, a correction of only 3′ in the moon's latitude, for an epoch anterior by more than 21 centuries to that of the tables), yet it did not escape Mr. Baily's notice, nor did his love of truth permit him to conceal the fact, that no presumed single correction of the tabular elements will precisely reconcile *both* eclipses with their strict historical statement. There seems, however, no reason to doubt that the eclipse of 610 B.C. is, in fact, the true eclipse of Thales. It seems extraordinary that neither Professor Oltmanns, who investigated the eclipse of Thales about two years subsequently, and who came to the same conclusion, nor M. Saint Martin, who read an elaborate memoir on the same subject to the French Institute in 1821, should have made any mention of this very remarkable paper of Mr. Baily.

The *Epitome of Universal History*, of which mention has already been made, was published in 1813, and intended to accompany an *Historical Chart* published the year before, an extension and improvement of Dr. Priestley's, in which the political alterations of territory are represented through the whole of history. It is an easy and useful work of reference, in which the number and accuracy of the dates, and the utility of the appended tables, are especially valuable. There can be little doubt that the object of this work was much less to produce a book than to systematise and concinnate the author's own knowledge. When such a task is undertaken by a mind at once vigorous in its grasp, and simple, practical, and natural, in its points of view, it can hardly fail to result in a picture of the subject where all the parts are truly placed, and easily apprehended by the general reader. The chart with its explanation, forming a distinct work, was in considerable request, and went through three editions in five years.

About the 22d of January, 1814, occurred the celebrated fraud of De Beranger, that being the assumed name of an impostor employed to bring important but false intelligence from the scene of war abroad, for the purpose of influencing the price of the British funds. The imposture was so adroitly managed that many bargains were made on the strength of this intelligence, and much confusion caused. In the detection and exposure of this fraud,

Mr. Baily had a considerable share, and was appointed by the committee of the Stock Exchange to get up the evidence against the perpetrators,—a task which he is said to have performed in so masterly a manner, that no more complete and conclusive chain of evidence was ever produced in a court. The result of these inquiries, and the steps taken in consequence, were made the subject of three Reports of the above-mentioned committee, drawn up by him, and printed in that and the subsequent year.

From this time, astronomy appears to have been continually engaging more and more of his attention. The subject of eclipses and occultations with their connected calculations, together with that of the improvement of the Nautical Almanac, which, whatever might be said on specific points, had certainly, at that time, begun to fall considerably behind the requisitions of astronomical, and even of nautical science, were those with which he may be said to have commenced his more active astronomical career. But I wish to call attention at present to two pamphlets which he published in 1818 and 1819 respectively, which will afford occasion for some remarks of moment. The first of these is a notice of the annular eclipse of September 20, 1820, whose path lay along the whole medial line of Europe from north to south. Two points in this tract merit our attention. In it he adopts a practice, which he subsequently on a great many occasions adhered to, of introducing in the way of prefatory statement a brief but very clear sketch of the history of the subject, and the observations of former astronomers. These little historical essays are for the most part extremely well drawn up, and highly interesting, and shew a perfect knowledge of the subjects treated of, drawn from very extensive reading. The next point, and one of more importance, is the studious consideration shewn to observers possessed of slender instrumental means, in pointing out to them modes and forms of observation by which those means might be rendered available and useful. At no period of his life himself possessing any large and elaborate instrument or luxurious appliances, one of his constant aims was to render astronomical observation popular and attractive by shewing that much of a highly useful character might be accomplished with even moderate instruments. There is no question more frequently asked by the young astronomer who has possessed himself of one or two tolerably good instruments which he desires to employ his time upon, than this, "How can I make myself useful?" nor any which can be more readily answered by a reference to the innumerable notices on almost every point of practical astronomy which Mr. Baily from this time forward for many years continued to scatter profusely to the public, and which have probably done more to create observers, and to cherish and foster a taste for practical astronomy among Englishmen, than any single cause which can be mentioned.

In 1819 he printed for private distribution a translation of Cagnoli's memoir on a "Method of deducing the Earth's Ellipticity from Observations of very Oblique Occultations," with an appendix

recommendatory of the method which is precisely such as requires for its perfect execution only a sufficient telescope, a moderately good clock, and an observer diligent in watching opportunities. This was, no doubt, Mr. Baily's chief reason for translating and distributing it, and for subsequently following it up by his chart and catalogue of the Pleiades, through which the moon had to pass at each lunation in 1822 and the following years, thereby affording admirable opportunities for applying the principle in question. I should not, however, have thought it necessary, in the midst of so many claims on our notice, to draw especial attention to this work, but for one passage in it deeply interesting to all of us. I mean that in which he alludes to the formation of an Astronomical Society as an event earnestly to be desired.

"It is much to be regretted," he observes, "that in this country there is no association of scientific persons formed for the encouragement and improvement of astronomy. In almost all the arts and sciences institutions have been formed for the purpose of promoting and diffusing a general knowledge of those particular subjects.....the beneficial effects of which are too evident to be insisted on in this place. But astronomy, the most interesting and sublime of the sciences.....cannot claim the fostering aid of any society.....The formation of an ASTRONOMICAL SOCIETY would not only afford this advantage, but would in other respects be attended with the most beneficial consequences," &c. &c.

It is thus that coming events cast their shadows before them. But looking back from this point, as it were, to the then embryo state of our corporate existence, it would be ungrateful not to associate with the name of Francis Baily that of Dr. Pearson, as having at or about the same time made the same suggestion. It was happily and speedily responded to, and on Wednesday the 12th of January, 1820, a preliminary meeting of the fourteen founders of our Institution took place, which resulted in its final establishment, and in which during the first three years of its existence Mr. Baily filled the office of secretary, in other words, undertook and executed the more laborious and essential duties. The establishment of this Society may, indeed, be considered as a chief and deciding epoch in his life, and to have furnished, though not the motive, yet, at least, the occasion, for the greater part of his subsequent astronomical labours. Looking to it, as every one must do, as a most powerful instrument for the advancement of the science itself, and the propagation of a knowledge of and a taste for it among his countrymen, he yet appeared to regard it as something more than simply as a means to an end. He made it an object of personal attachment and solicitude, which led him to watch over its infant progress with parental care, and to spare no exertion in its behalf. As years passed on, and as the Institution flourished (as every institution must do which is constituted on sound principles, whose members are loyal to those principles, and willing to work heartily in its cause), this sentiment, so far from diminishing, seemed to grow upon him till he regarded its welfare

and interests as identical with his own. I shall reserve a more distinct statement of our obligations to him for a more advanced period of this notice; but in a narrative of his life it becomes impossible from this epoch to separate the Astronomical *Society* from astronomical *science*, in our estimate of his views and motives, or to avoid noticing the large and increasing devotion to its concerns of his time and thoughts. To the Transactions of the new Society he became, as might be expected, a frequent and copious contributor. In the interval between the first establishment of the Society and the year 1825 (the reason for this limit will presently be seen), he contributed five papers, viz.: "On the Meridian Adjustment of the Transit Instrument;" "On the Determination of Time by Altitudes near the Prime Vertical:" "On the Solar Eclipse of September 20, 1820;" "On the Mercurial Compensation Pendulum;" and "On the Determination of Longitudes by Moon-culminating Stars." The two first-mentioned of these turn on somewhat elementary points of astronomical observation, and contain tables, and suggest facilities, which he had found useful in his own practice. The eclipse was observed by him at Kentish Town, where not being annular, he must have felt severely the sacrifice, imposed probably by the calls of business, of the opportunity of witnessing by a short continental trip, a phenomenon which had engaged so much of his thoughts. His paper on the Mercurial Pendulum, though practical in its object, was of a much more elaborate kind than any thing which had previously emanated from him, with exception of his memoir on the eclipse of Thales. It contains a minute and excellent view of the whole subject of this most useful compensation; is prefaced (*more suo*) with a clear synoptic view of the then actual state of the subject, and goes into the whole subject of the expansion of the materials, the formulæ for determining with more precision than heretofore the proportional length of the mercurial column, and the mode of adjustment both for rate and compensation. This paper must certainly be regarded as a very valuable one, and an astronomer can hardly be said thoroughly to understand his clock who does not possess it. The object of the paper on moon-culminating stars is to recommend, facilitate, and render general, that most useful and widely available method of determining the longitude on land.

About this period, also, Mr. Baily began, and thenceforward continued, to be a frequent contributor to the *Philosophical Magazine*, published by Messrs. Tilloch and Taylor, of articles interesting in a great variety of ways to the practical astronomer. These articles are so numerous, and so miscellaneous in their subject matter, that it would be vain to attempt any detailed account of them, within such limits as I must confine myself to. Nor, indeed, is it requisite to do so; as many of them, however useful at the time, have now ceased to present any especial interest, apart from their general object, which was that of diffusing among the British public a knowledge of the continental improvements in the art of observing, and the practice of astronomical calculation, and placing

in the hands of our observers and computers a multitude of useful tables and methods, which, though sure to work their way ultimately into use, were undoubtedly accelerated in their introduction into English practice by coming so recommended. More special objects were those of recommending to general attention and use certain eminently practical methods, such as those of determining latitudes by the pole-star, longitudes by moon-culminations and occultations, copious lists of which were, on several occasions, either procured from abroad and reprinted here, or calculated by himself for the purpose.

The circulation of notices, also, of other remarkable expected phenomena, with a view to procuring them to be observed,—the description of newly invented foreign instruments, or of such as had been long known but little used in England,—the analysis of foreign astronomical publications,—every thing, in short, which could tend to excite curiosity, to cherish emulation, and to render the British astronomical mind more excursive and more awake than heretofore, found a place in these contributions; of which so constant and copious a fire was kept up, as may well excite our surprise at the industry which sustained, no less than our admiration of the zeal which prompted it.

A volume of astronomical tables and formulæ, printed in 1827 for private distribution (as was frequently his custom), and then largely circulated, but since published with corrections, is of the utmost convenience and value, and will be highly prized by every astronomer who may be fortunate enough to possess a copy, as a work of ready and continual reference for all the data and coefficients of our science. A series of zodiacal charts was also commenced by him, but I am not able to say if more than one plate was engraved.

One of the most practically important and useful objects, however, to which Mr. Baily's attention was about this period turned, was the facilitating, by tables properly contrived for the purpose, the reductions of apparent to mean places of the fixed stars. It seems almost astonishing that these computations, which lie at the root of all astronomy, and without which no result can be arrived at, and no practical observer can advance a single step, should have remained up to so late a period as the twentieth year of the nineteenth century, in the loose, irregular, and troublesome state which was actually the case, and *that* not from their theory being ill understood, but from their practice not having been systematized. Each of the uranographical corrections had to be separately computed by its own peculiar tables, and with coefficients on whose magnitude no two astronomers agreed. The latter evil, indeed, might be tolerated at a time when the tenth of a second of space was not considered of so much consequence as at present, but the calculations were formidable and onerous in the extreme to private astronomers, whatever they might be rendered in public establishments by habit and the use of auxiliary tables. So far as the fundamental stars were concerned, the subject had for some time attracted attention, and had begun to receive its proper remedy by

the publication, by Professor Schumacher in Denmark, of their apparent places for every tenth day; and by the laudable exertions of Sir James South in our own country, who, for some years, prepared and circulated similar tables for every day, not without urgent representations of the necessity of taking it up as a public concern, which was at length done. But for stars out of this list, except about 500 somewhat facilitated by Zach, there was no provision of any kind, nor any auxiliary tables to have recourse to; so that sidereal astronomy, beyond the bounds of this favoured list, might be almost said to be interdicted to the private astronomer, owing to the excessive irksomeness of these calculations. This was precisely the sort of case for Mr. Baily to take pity on. He perceived a desert where, with a moderate expenditure of capital, a plentiful harvest might be made to grow, and forthwith proceeded to remedy the evil. Accordingly, with the aid of Mr. Gompertz, he investigated the subject generally, and succeeded in devising a method of arranging the terms of the corrections for aberration, solar and lunar precession, adapted to the purpose, and identical in principle with that adopted by M. Bessel, who, on his part, was at the same time, and, actuated by the same motives, engaged on the subject unknown to Mr. Baily. The latter had actually proceeded to the computation of his tables, when the labours of Bessel reached his knowledge, who had, moreover, included the precession under the same general mode of expression. Mr. Baily, with characteristic frankness and candour, immediately acknowledged this as an improvement in advance of his own idea, and at once adopted and recommended it for general use. He did more, he carried out the idea into a wide and most useful field; and in the Catalogue of the Astronomical Society he has put the astronomical world in possession of a power which may be said, without exaggeration, to have changed the face of sidereal astronomy, and must claim for him the gratitude of every observer. It detracts nothing from the merit of Mr. Baily, or from his claim to be considered the author of this precious work, that the numerical computations were chiefly executed by Mr. Stratford, and the expenses borne by the Astronomical Society. The conception was all his own, and the work prefaced, explained, and superintended, in every stage of its progress, by himself alone. The gold medal of this Society was awarded to him for this useful work.

On the 22d February, 1821, Mr. Baily was elected a Fellow of the Royal Society. He was also a Member of the Linnean and Geological Societies, but I am unable to state the precise date of his election in either.

In 1825 he retired from the Stock Exchange, after a career in which his consummate habits of business, his uprightness, intelligence, and prudence, had established his fortune, and might, if continued, have led him on to any eminence of worldly wealth. But there was that in his disposition which the mere acquisition of wealth could not satisfy. All that he had before done for his favourite science seemed only preparatory to what he might do; and with

the best years of his intellectual life before him, and with objects worthy of his efforts now opening to his view in that direction, he resolved henceforward to devote himself to their pursuit, though at the sacrifice of prospects whose attractions always prove irresistible to minds of a lower order. In thus calmly measuring the relative worth of intellectual and worldly pursuits, and stopping short in the full career of success, when arrived at a point which his undazzled judgment assured him to be the right one, he afforded an example of self-command as uncommon as it was noble. In the satisfaction which the decision afforded him, and the complete fulfilment of those aspirations which led him to form it, we have one proof (if proofs be wanting) how entirely a well-chosen and elevated scientific pursuit is capable of filling that void in the evening of life, which often proves so intolerably irksome to men who have retired early from business from mere love of ease or indolence. On no occasion did he ever appear to regret the sacrifice he had made, or even to regard it as a sacrifice.

No desire of listless ease or self-indulgence, however, could by possibility have mixed with Mr. Baily's motives in taking this step; for immediately on doing so he entered on a course of devoted and laborious exertion, which continued without interruption during the remainder of his life, and of which the history of science affords few examples. The mass of work which he got through, when looked at as such, is, in fact, appalling, and such that there seems difficulty in conceiving how it could be crowded into the time; the key to which is, however, to be found in his admirably conceived methodical arrangement of every piece of work which he undertook, and his invaluable habit of finishing one thing before he undertook another.

At this epoch, or very shortly subsequent to it, he purchased and took up his permanent residence in his house in Tavistock Place, excellently adapted in every respect both to his future comfort and convenience as a place of abode, and for those important and delicate researches of which it was destined to become the scene; standing, as it does, insulated in a considerable garden, well-enclosed on all sides, and, from the nature of the neighbourhood, free from any material tremor from passing carriages. A small observatory was constructed in the upper part, for occasional use and determination of time, though he never engaged in any extensive series of observation. The building in which the earth was weighed and its bulk and figure calculated, the standard measure of the British nation perpetuated, and the pendulum experiments rescued from their chief source of inaccuracy, can never cease to be an object of interest to astronomers of future generations.

In endeavouring, according to the best of my ability, to give some account of the astronomical labours of Mr. Baily subsequent to this period, it will no longer be advisable to adhere, as I have hitherto done, to the chronological order in which they were undertaken and executed. It will rather be preferable (with exception

of a few memoirs and publications of a miscellaneous nature) to consider them under distinct heads, according as they refer to one or other of the following subjects, viz.:—

1. The Remodelling of the *Nautical Almanac;*
2. The Determination of the Length of the Seconds-Pendulum;
3. The Fixation of the Standard of Length;
4. The Determination of the Density of the Earth;
5. The Revision of Catalogues of the Stars;
6. The Reduction of Lacaille's and Lalande's Catalogues; and,
7. The Formation of a New Standard Catalogue.

The Nautical Almanac.—The end of the eighteenth and the commencement of the nineteenth century are remarkable for the small amount of scientific movement going on in this country, especially in its more exact departments. It is not that individuals were not here and there busied in extending the bounds of science even in these, but they met with little sympathy. Their excursions were limited by the general restriction of view which had begun to prevail, and by a sense of loneliness and desertion (if I may use such an expression) arising from that want of sympathy. Mathematics were at the last gasp, and astronomy nearly so; I mean in those members of its frame which depend upon precise measurement and systematic calculation. The chilling torpor of routine had begun to spread itself largely over all those branches of science which wanted the excitement of experimental research. I know that I have been blamed on a former occasion for expressing this opinion, but it is not the less true, though we may now happily congratulate ourselves that this inanimate period has been succeeded by one of unexampled activity. To break the dangerous repose of such a state, and to enforce that exertion which is necessary to healthy life, there is always need of some degree of friendly violence, which, if administered without rudeness, and in a kindly spirit, leads at length the revived patient to bless the disturbing hand, however the urgency of its application might for a moment irritate. It is in this light that we are to regard the earnest and somewhat warm remonstrances of Mr. Baily on the deficiences which had long begun to be perceived and felt in the *Nautical Almanac*, in its capacity of an astronomical ephemeris.

The subject once moved gave rise to a great deal of discussion, from more than one quarter, which was from time to time renewed for some years; but as I have no intention to make this notice an occasion of dilating on any matter of a controversial nature, I shall merely add that, on the dissolution of the late Board of Longitude, followed almost immediately by the death of Dr. Young, on whom the charge of its superintendence rested (the new Berlin Ephemeris, by Encke, having also recently appeared, in which many of the principal improvements contended for were adopted), it seemed fitting to the Lords Commissioners of the Admiralty to place unreservedly before the Astronomical Society the

subject of a complete revision and remodelling of that great national work—a high proof of confidence, which speaks volumes for the good sense, prudence, and activity which had continued to pervade its administration during the ten years which had now elapsed since its first institution.

It is hardly necessary to add that this important business received the most unremitting attention from Mr. Baily, as well as from every other member of the Committee, in all its stages. To him also was confided the task of drawing up the final report of the Committee appointed to carry out the wishes of the Admiralty, which will be found in the fourth volume of our *Transactions*, and which is a model of good sense, clearness, and lucid arrangement. The Report was immediately acted upon by Government, and the result was the present British *Nautical Almanac;* a work which, if it continue to be carried on, as I trust it ever will, on the principles which prevailed in its reconstruction, will remain a perpetual monument to the honour of every party concerned in it.

The Pendulum. — The seconds-pendulum having been constituted the legal source from which, in the event of the loss of the national standard of length, the yard might at any time be recovered, it may be easily imagined with what intensity of interest the announcement was received among all conversant with these fundamental determinations, that a very material correction had been entirely overlooked in the reduction of the experiments, on which the Act of 5 Geo. IV. c. 74 was founded. This correction is, in fact, no other than the correction due to *the resistance of the air*, and, placed in this light, it would seem somewhat wonderful that such an oversight could have been committed; but it had been customary to consider the effect of resistance on the time of vibration to be wholly confined to its influence in diminishing the arc, and this secondary effect being allowed for in the formulæ employed to compute what is called the correction for the arc of vibration, the primary or direct effect of resistance dropped altogether out of notice, or, rather (owing to an entire misconception of the nature of the mechanical process by which resistance is operated), had been supposed to be altogether inappreciable in its amount. The real effect of resistance, though under a somewhat confused statement as to its nature, had, however, been long before noticed, and its amount even ascertained with tolerable correctness by the Chevalier Buat, in 1786; but his experiments and theory had so entirely fallen into oblivion as to have escaped the notice not only of Captain Kater, but of his own countrymen, Borda and Biot, and were unknown even to Bessel himself, who, in 1828, rediscovered the correction in question, and, for the first time, made it an integrant feature in the modern system of pendulum reductions. The light in which this correction was placed by Buat, and even in some respects by Bessel, tended not a little, in my opinion, to obscure the clear perception of its nature, by representing it as due to a certain portion of air adhering to and bodily *dragged along* by the pendulum in its motion, thus adding to its inertia without ad-

ding to its relative weight when corrected for buoyancy; and in this view, also, Mr. Baily regarded it. That this is not a complete and adequate view of the subject is easily made a matter of ocular inspection, by causing a pendulum to vibrate, or any body to move, near the flame of a candle, when it will be at once evident that the movement of the air consists in the continual transfer of a portion of air from the front to the rear of the body, by performing a circuit half round it. Its hydrodynamical investigation, therefore, is of an infinitely higher order of difficulty than the ordinary problems of resistance, which turn upon a theory of molecular impulse, simple indeed, but very far from satisfactory. It properly refers itself to the theory of sound, and has, in fact, been so investigated in an admirable memoir by Poisson.*

But to return from this digression (which, however, will not have been without its use, if it shall tend to diffuse clear conceptions of the subject, and to disentangle from one another corrections which seem to have got unduly mixed up together in the minds of practical inquirers). No sooner were the ideas of M. Bessel promulgated in England than Captain Sabine, whose attention was pointedly directed to a subject which had occupied so large and active a portion of his life, resolved to ascertain the true amount of this new, or newly mentioned, correction, in the only way in which it could be effectually done, viz. by vibrating the pendulum *in vacuo*, which he accordingly effected by a series of highly interesting experiments, carried on at the Royal Observatory at Greenwich, and recorded in the *Philosophical Transactions*, in a paper read March 12, 1829. His result makes the total reduction to a vacuum about one and two-thirds of that usually called "the correction for buoyancy." It should, however, be borne carefully in mind that the particular correction now in question has, in fact, nothing whatever to do with the buoyancy correction, either in its mode of production or its form of expression, and ought, therefore, to be very studiously kept apart from it in all theoretical views, though of course they must be numerically amalgamated in the "reduction to a vacuum."

Meanwhile the attention of Mr. Baily had, about the same time, been called to the pendulum, in consequence of the contemplated expedition about to sail under the command of Captain Foster, on that memorable and most unfortunate expedition which cost him his life. It was on this occasion, and with a view to the use of this expedition, that Mr. Baily (still acting for the Astronomical Society, whose aid had been requested in suggesting useful objects of inquiry) devised that capital improvement in the

* If this view of the subject be correct, as I am persuaded it is, it seems not impossible that, by making a section of the pendulum coincident in form with the "wave-formed outline" of Mr. Russel's ships, the resistance correction might be annihilated altogether, or so nearly as to render it quite inappreciable.

I trust that, in what is said above, I shall not be supposed to undervalue M. Bessel's analytical treatment of this intricate problem, especially as it conducts to results which, regarded as a first approximation, represent sufficiently well the results of experience.

system of itinerant pendulum observation, which consists in making each transferable pendulum a convertible one, by the simple addition of another knife-edge, and in doing away with extra apparatus of tail-pieces, sliders, &c., by the initial adjustments of the instrument. And I may here incidentally remark, that the general principles of reducing, as far as possible, the number of moveable parts in every instrument intended for standard determinations of whatever kind, is one which cannot be too strongly recommended, and has been successfully acted on by the present Astronomer Royal in more than one recent construction. Two pendula, a copper and an iron one, on Mr. Baily's principle, were furnished by the Society for this expedition, an account of which may be found in the *Notices* of the Society for June 13, 1828.

The adjustment and trial of these pendula previous to the sailing of the expedition, were performed by Mr. Baily at his own house, and, thus engaged in actual experiment, he at once became led on into a minute examination of all the possible sources of practical error in the experiments, and consequent uncertainty in the important results of which they had become the basis. It was in this stage of his experience that he became acquainted with Professor Bessel's results, which determined him (as it had already done Captain Sabine) to go into the whole subject of the new correction by experiments performed *in vacuo*. But not content with assuming any fixed proportionality between it and the buoyancy correction, he resolved so to vary the form, magnitude, and materials of the vibrating masses, as to make its true nature and amount an object of inductive experimental inquiry; thus, though adopting the language of Buat and Bessel, disengaging himself in effect from any theoretical view of the *modus operandi* or mechanical process by which the effect was produced.

The result of these inquiries was a very elaborate and masterly paper read to the Royal Society, on the 31st of May, 1832, containing the results of experiments in air and in vacuo, on upwards of eighty pendulums of various forms and materials, by which the new correction is clearly shewn to depend not only on the dimensions but on the form and situation of the vibrating body. Independent of the excellence of this paper as a specimen of delicate experimental inquiry and induction, in which, to use the expression of one best capable of appreciating and admiring them, his generalizing powers seem to have been held in abeyance till the right moment for their exercise arrived, it had the further merit of bringing into distinct notice a number of minute circumstances, chiefly relative to the mode of suspension (important, however, from their influence on results), which it is absolutely necessary to attend to in these delicate and difficult inquiries, if the pendulum be ever again resorted to as a means of verifying or fixing anew the standard of length.

The return of the Chanticleer in 1831, without its lamented commander, threw the whole task of arranging and digesting for publication Captain Foster's pendulum observations on Mr.

Baily—a labour of love, prompted by the warmest friendship, and which he executed in the spirit of one determined to erect a monument to the fame of that truly amiable and talented officer, of the most durable and precious materials. His Report on the subject to the Admiralty was presented by the Lords Commissioners to the Council of the Astronomical Society, and printed at the expense of Government as the seventh volume of our *Transactions*. In this Report the observations are given in full, and with the most scrupulous fidelity, and those at each of the numerous stations discussed with the utmost care. The final re-examination of the pendulums in London was also personally executed by Mr. Baily, and the whole series of stations combined into a general result, which gives for the ellipticity of the earth $\frac{1}{289 \cdot 48}$. Not content with this, he has here also collected into one synoptic view the results obtained at various stations all over the globe with the invariable pendulum, by observers of all nations, so as to place them in comparison with each other, and to deduce from them a general result. Of these, by far the most numerous and prominent, in every respect, are those of our own countrymen, Captains Foster and Sabine; and nothing can be more gratifying, in estimating our own national share in this sublime application of science, than to find these principal authorities, whose observations were made and reduced with the most absolute independence of each other, agreeing at all the stations where they admit of comparison, with a precision truly admirable. In fact, the greatest disagreement of each of their final results, from a mean of them both, amounts to a quantity less than half a vibration out of 86,400, or in a mean solar day.*

Standard of Length.—From the pendulum to the standard of length, or the fixation of the *scientific unit*, the transition is easy, and, in Mr. Baily's case, was unavoidable. For, being once satisfied by experience of the innumerable minute circumstances on which perfect precision in these inquiries depends, and finding the parliamentary enunciation of the relation between the conventional and natural standards nullified, as it were, under his eye, he felt himself irresistibly urged to inquire how far the conventional unit itself might be depended upon, and within what limits of error it might certainly be reproduced in copies. His first step in this direction was to obtain the most perfect possible representative of this unit, and (as the Astronomical Society was now identified with almost all his undertakings) justly considering the possession of such a standard by that body as a thing in itself desirable, and the instrument itself likely, if thoroughly well executed, to become in its hands of universal scientific reference, he procured himself, to be named by the Council, a Committee for superintending its execution, and comparing it with the most authentic standards at present existing in this country. Perhaps there is no subject of

* The stations of comparison are London, Maranham, Ascension, and Trinidad. Taking London for a term of departure, each station affords a ratio whose extremes (see *Report*, p. 86) differ only by 0·0000103, the half of which multiplied by 86,400 gives $0^{s}\cdot44446$.

inquiry more perplexing, or one whose investigation calls for more patience and perseverance, than the detection and exact estimation of those minute sources of error which influence these delicate measurements, which can only be satisfactorily performed by endless repetition and systematic variation of every circumstance by which error can possibly be introduced. Another and peculiar source of annoyance, and even vexation, consisted in the rough and careless usage to which those precious instruments, on which the conservation of our national units depends, had been subjected in too many instances, by which rude and ignorant hands had irrecoverably marred some of those refined productions of human workmanship, which ought not even to be approached but with precaution, or touched but with the utmost delicacy. Few things seem to have excited Mr. Baily's indignation more than the continual occurrence of evidence, only too palpable, of the small respect in which these standards appear to have been held by those under whose protection they had been placed, and of the violence which has been repeatedly suffered to be perpetrated on them.

I shall by no means go into any minute analysis of the admirable "Report" to the Council of this Society, which contains his account of the construction of our standard scale, its comparison with the parliamentary standard, and its most authentic existing representatives—and with the French metre, as we have it represented in this country by two platina metres, in the possession of the Royal Society; or the means taken to secure it from loss, by the formation of carefully compared copies, two of which have been sent abroad, and two retained in England. Suffice it to say, that the delicacy of the means employed, the minuteness of the precautions used, and the multiplicity of the comparisons, surpassed every thing of the kind which had ever before been done in this country. This Report, too, is valuable in another way. Under the modest title of *A Short History of the Standard Measures of this Country*, it presents a summary of the subject so complete as almost to obviate the necessity of referring elsewhere for *historical* information.*

The immediate result of this useful and most laborious undertaking has been to put this Society in possession of, perhaps, the most perfect standard measure and divided scale in existence, in which every division, even to the individual inches, has been micrometrically verified, and their errors ascertained and placed on record. It would almost seem, too, as if a prophetic spirit had actuated the undertaking, and urged it to its completion without any of those delays which so often and proverbially attend the

* Mr. Baily was assisted in the actual comparisons by several Fellows of the Society, among whom the late Lieut. Murphy was conspicuous, an observer whose temper and scientific habits peculiarly fitted him for co-operating with Mr. Baily, and whose name would probably have occurred more than once in this memoir but for his untimely death, which took place in the service of Astronomy in a distant region, and was probably the unfortunate consequence of over-exertion in its cause.

construction and optical examination of delicate instruments. For the comparison of the new scale with the imperial standard yard had hardly been completed six months, when the latter, together with the other original standard by Bird (that of 1758), as well as the imperial standard of weight, were destroyed in the conflagration of the Houses of Parliament in October 1834. Thus the operation in question has been the fortunate means of preserving, to the latest posterity, that unit which has pervaded all our science, almost from the first dawn of exact knowledge.

The scientific unit is indeed preserved; but the nation remained, and remains up to this moment, without a legal standard either of weight or measure. In the early part of 1838, however, in consequence (as I have been led to understand) of some communications on the subject between Mr. Baily, Mr. Bethune, and the Astronomer Royal, the latter was induced to draw the attention of Government to the subject, an occasion having arisen which rendered the mention in an official form unavoidable. And on the 11th of May of the same year a commission was appointed, consisting of seven* members (Mr. Baily being one), to report on the course most advisable to be pursued under these circumstances. To this duty, which involved the hearing of a vast deal of evidence and much personal attendance, Mr. Baily gave his unceasing attention; suggesting many valuable points, both practical and theoretical; and, on the Report of the Commission being agreed on, and the practical formation of new standards, in conformity with the view therein taken of the subject, being referred by Government to the same commissioners, Mr. Baily undertook, to the general satisfaction of the whole body, and at their particular request, the delicate and important task of reconstructing the standard of length—a task which, unhappily, he did not live to complete. On whomsoever may devolve the completion of this standard, it will be satisfactory to the Members of this Society to know that, among the evidence adduced for its restoration, the scale prepared for it by Mr. Baily necessarily forms a most important and prominent feature.

Density of the Earth.—The accurate determination of one fundamental quantity naturally leads to inquiry into others. To make our globe the basis of measurement for the dimensions of the planetary system and of the visible universe, its form and magnitude must first be accurately known. To make it afford a scale by which the masses and attractive forces of the sun and planets can be expressed in terms conveying a positive meaning, its density must be ascertained, as compared with that of substances which occur on its surface, with which our experience is familiar, and from which our notions of material existence are drawn. The fine experiment of Cavendish, confirmed as it was, in its general result, by the operations on Schehallien, had satisfactorily demonstrated the continuity of the Newtonian law of gravity, from such vast distances as astronomy is conversant with, through the inter-

* An eighth was subsequently added.

mediate steps of the diameters of the earth, and of a mountain, down to those minute intervals which intervene between the parts of a philosophical apparatus, and their agreement within as moderate limits as could have reasonably been expected, had even led to something like a probable estimate of the earth's density, which, however, could never be regarded as satisfactory, otherwise than as a first step towards more precise determinations. Mr. Baily's labours, therefore, on the pendulum were hardly brought to a conclusion when he was led to enter upon this subject, the immediate occasion of his doing so being an incidental suggestion at the council table by Mr. De Morgan, of the desirableness of repeating the experiment of Cavendish*—a suggestion immediately seconded both by the Astronomer Royal and by Mr. Baily. The experience of the latter had shewn him how indispensably necessary, in such inquiries, are extensive repetition and variation of circumstance. The Schehallien experiment, from its very nature, admitted of neither; and, on carefully examining Cavendish's record of his own experiment, he found abundant reason to perceive how much was left to be desired, in both these respects, even in that form of the inquiry.

In resolving on a repetition of this experiment, the difficulty of the undertaking itself, and his own preparation for it, must have been, and no doubt were, very seriously considered. However confident in his own resources and perseverance, it was no holiday task in which he was now about to engage. The pendulum experiments, with all their delicacy, could hardly be regarded as more than an elementary initiation into the extreme minuteness necessary for this inquiry. There are two branches of research in physical astronomy which task to the utmost the resources of art, the delicacy of manipulation, and the perseverance of the inquirer—the parallax of the fixed stars and the density of the earth. In both, an immense object has to be grasped by the smallest conceivable handle. But, of the two problems, the latter is probably that which throws the greatest burden on the inquirer, inasmuch as it is not merely a series of observations to be carried on under well-ascertained circumstances and known laws, but a course of experiments to be entered on for eliminating or controlling influences which war against success in every part of the process, and where every element, nay, even the elementary powers of heat, electricity, magnetism, the molecular movements of the air, the varying elasticity of fibres, and a host of ill-understood disturbing causes, set themselves in opposing array in their most recondite

* *Fiat justitia, ruat cœlum.* The original design of this beautiful experiment was Mitchell's, who actually constructed the identical apparatus which Cavendish used, but died before he could execute the experiment. The apparatus came, after his death, into the possession of the Rev. W. H. Wollaston, D.D., *who gave it* to Cavendish, who used it, indeed, to excellent purpose, but who assuredly neither devised the experiment, nor invented, nor constructed, nor even, so far as I can perceive, materially improved the apparatus. All this is distinctly stated by Cavendish himself, who is, therefore, noway to blame for any misconception which may prevail on the subject.

and unexpected forms of interference. Nor could it have been overlooked by him that it was necessary, not merely to do over again what Cavendish had done before him, a thing in itself not easy, but to do it much more thoroughly and effectually.

Mr. Baily, however, was not to be discouraged by such considerations. He saw that there existed a blank in our list of exact data which it was necessary to fill, and he felt himself in possession of those gifts of nature and position which enabled him to fill it. Accordingly, in 1835, on the occasion above alluded to, the Astronomical Society appointed a committee to consider the subject; and Mr. Baily having offered to perform the experiment, in 1837, the Government (at the instance of Mr. Airy) granted the liberal sum of 500*l.* to defray the cost of the experiment.

This great work was brought to a satisfactory conclusion in 1842, and a complete account, with a full detail of the experiments, printed in one volume, published in 1843, forming the fourteenth of the series of *Transactions* of this Society. The experiments were varied with balls of different materials, and with suspensions no less various, combined so as to form no less than 62 distinct series, embodying the results of 2153 experiments; and which, formed into groups according to the nature of the combination, afford 36 distinct results, taking those only in which the balls were used, the extremes of which are 5·847 and 5·507, and the most probable mean 5·660, none of them being so low as Cavendish's mean result, 5·448. The probable error of the whole (0·0032) shews that the mean specific gravity of this our planet is, in all human probability, quite as well determined as that of an ordinary hand-specimen in a mineralogical cabinet,—a marvellous result, which should teach us to despair of nothing which lies within the compass of number, weight, and measure. I ought not to omit mentioning, that, of all the five determinations of this element we possess, Mr. Baily's is the highest.*

Though it would be equally remote from my present purpose, and superfluous in presence of such an assembly, to enter minutely into a discussion of these experiments, there is one point in their conduct which I cannot pass over in silence. The experiments had been carried on for eighteen months, a vast number of preliminary trials had been made, and upwards of 1000 registered results obtained, when it became apparent that the coincidence of Cavendish's results, one with another, was rather to be attributed to the paucity of his trials than to any especial accuracy in his observations or felicity in his mode of operating. Even in the few experiments made by Cavendish, discordances had shewn themselves, of

* The five determinations alluded to are, in order of magnitude, as follows:—

Schehallien experiment from Playfair's data and calculations	Max. 4·867	Min. 4·559	Mean 4·713
Carlini, from pendulum on Mont Cenis, corrected by Giulio			4·950
Reich, Repetition of Cavendish's expt. (most probable combination)			5·438
Cavendish, computation corrected by Baily			5·448
Baily (most probable combination)			5·660

which no account could be given other than by reference to the movements of included air; but, on Mr. Baily's extensive scale of operation, the limits of disagreement obviously arising from this cause became so enormous as to render it hardly possible to draw any line for the reception and rejection of results. In fact, at one period he had almost begun to despair of bringing the matter to any positive conclusion. The happy suggestion of Mr. Forbes, *to gild* the torsion-box and leaden balls, at once dispelled all this vagueness and uncertainty, and reduced the results to a high degree of uniformity.* Most experimenters would have been content to reject the discordant results. Mr. Baily unhesitatingly sacrificed the whole, and began anew, without appearing to regard with an instant's regret the time and labour lost. The gold medal of this Society was awarded to him for this important memoir.

Revision of Catalogues of the Stars.—The contributions of Mr. Baily to this branch of sidereal astronomy are so numerous and so important, as alone would suffice to rank him among the greatest benefactors to the science, since, without being himself an observer, he has conferred, by his indefatigable industry and perseverance in collating authorities, rescuing original observations from oblivion, and rectifying printed errors, a vast and unhoped-for accession of value to the works of all those on whom he has commented. In fact, this, which may be termed the archæology of practical astronomy, formed his staple and standing work, which, though from time to time interrupted by other subjects, was always resumed; always with increasing interest, and always on a larger and more effective scale, up to the very year of his death. His object appears to have been, so far as is now practicable, to destroy the gap which separates us from the elder astronomers, and to multiply, or at least to preserve from further destruction, the links which connect us with them; to ascertain *all* that *has really been* recorded of the stars, and to make that totality of knowledge the common property of astronomers—a precious and a pious labour, of which we have no examples, except in that spirit of loyal reverence which prompted Ptolemy to secure from oblivion the observations of Hipparchus, and make them the foundation of all future astronomy; and in that which animated Bessel, when on the basis of Bradley's observations he may be said to have afforded the means of reconstructing the whole fabric of the science.

The catalogues which Mr. Baily has re-edited are those of Ptolemy, Ulugh Beigh, Tycho Brahe, Halley, Hevelius, Flamsteed, Lacaille, and Mayer; a mass of commentation, expurgation, and minute inquiry before which the most stout-hearted might quail, since there is not one of them in which each individual star has not been made the subject of a most scrupulous and searching examination, and in which errors that had escaped all prior detection,—

* This was not, however, the *only* precaution used. Mr. Baily carried out the suggestion, by swathing the torsion-box in flannel, and applying over this defence an exterior *gilded* case. Should the experiment ever again be repeated, it should be attempted *in vacuo*.

errors of reading, errors of entry, of copying, of calculation, of printing, out of number,—have not been detected and corrected. But for these labours, the catalogues of Ptolemy and Ulugh, indeed, must have remained sealed books to any but professed antiquaries; and although we can now hardly ever have occasion to appeal to these earliest authorities for any practical purpose, we cannot but look on the labour thus cheerfully bestowed in embalming and consecrating their venerable relics as the sure pledge that our own works, if really worthy, will not be suffered to perish by time and neglect.

But while we admire both the diligence and the scrupulous exactness, of which the notes appended to these catalogues bear ample evidence, we must not omit to mention, that there are two of them, those of Mayer and Flamsteed, in respect of which Mr. Baily's researches have been pushed far beyond the mere duties of comparison and comment, having been extended to the conservation and minute examination of the original records from which the catalogues were formed. In the case of Mayer, his influence with the late Board of Longitude secured the publication of the original observations of that eminent astronomer at Göttingen, which had never before seen the light.* In the case of Flamsteed, his labours were much more extensive, and require a more particular statement, inasmuch as not only Flamsteed's greatest work, the *British Catalogue*, found in him its restorer to that high rank, as an astronomical document, which it is justly entitled to hold, but the fame and character of its author their defender and rescuer from grievous misapprehension and misstatement.

In 1832 it happened, by a most singular coincidence, that Mr. Baily became aware of the existence, in the possession of his opposite neighbour in the same street, E. Giles, Esq., of the whole of Flamsteed's autograph letters to Abraham Sharp, and was permitted to peruse and copy them. Their perusal convinced him that Flamsteed's life, astronomical labours, and personal character, had never been fairly placed before the world, and induced him to examine with care the mass of his papers preserved (or rather neglected and mouldering) at Greenwich. His first care was to arrest the progress of their further decay. His next, to avail himself of the original entries of the observations, and of the manuscript records of the computations founded on them, to trace out the sources, and to rectify the numerous errors and inconsistencies of the *British Catalogue* as it then stood before the world, and to present it to the public under quite a new aspect—as a noble monument of its author's skill and devotion, and a work worthy of the age and country which produced it. Among the papers thus examined, however, were also found an almost complete autobiography of Flamsteed, and a voluminous correspondence illustrative of those points so painfully at issue between

* In 1826.

Flamsteed, Newton, and Halley, relative to the publication of the Catalogue and observations, and to other matters of a more personal nature, which had hitherto all along been stated in an infinitely more unfavourable light towards Flamsteed than that which appears from Mr. Baily's thorough and voluminous exposition of the whole affair, and the evidence of the almost innumerable letters which he has printed at length, truly and properly to belong to them. Indeed it seems impossible not to admit, on the evidence here produced, that great and grievous injustice was done, and hardship imposed, in these transactions, on Flamsteed, whose character stands forward, on the whole showing, as that of a most devoted and painstaking astronomer, working at extreme disadvantage, under most penurious arrangements on the part of government, making every sacrifice, both personal and pecuniary, and embroiled (as I cannot help considering, by the misrepresentations and misconduct of Halley) with the greatest man of his own or any other age, holding a position with respect to the Observatory, as Visitor, which, under mistaken impressions of the true bearings of the case, might cause severity to assume the guise of public duty.

The volume which contains this important work of Mr. Baily was commenced (as we have seen) in 1832, and published in 1835, a rapidity of execution truly astonishing, when we consider that the volume extends to nearly 800 pages quarto; that the notes to the Catalogue alone occupy no less than 144 of them closely printed, not a line of which but involves some question of identity, of nomenclature, of arithmetical inquiry, or of reference to other authorities; that the examination and selection of the letters and other biographical matter for publication was a matter of the utmost delicacy and responsibility; and that the preface, which contains Mr. Baily's own summary of Flamsteed's life, the introduction to the Catalogue and the Supplement, in further vindication of Flamsteed's character and justification of his own views of it,—are all of them works of a very elaborate nature, and of the highest interest.

Catalogues of Lacaille and Lalande.—But Mr. Baily's views were not confined to the mere correction of existing catalogues. The labour of the commentator and collator, which has filled and satisfied so many minds, was to him only a means to an end of real practical importance. His aim was to render readily available to every astronomer all recorded observations of the sidereal heavens which could be depended on. Two great masses of observation might be said to exist buried under their own weight, and affording matter of grief and reproach to astronomy, now to be exchanged for congratulation and triumph. These were Lacaille's observations at the Cape of nearly 10,000 stars, and those of D'Agelet and Michel Lefrançais Lalande at Paris, of nearly 50,000. Neither of these collections of observations had been more than partially reduced. Lacaille himself had performed this task for 1942 of his stars. A considerable number of the stars of the *Histoire*

Céleste (Lalande's observations) had also been reduced and catalogued by Bode. But the great mass of both remained unreduced and unarranged, though it is true that Lacaille had accompanied each page of his observations with a table of reductions, and that in 1825, Professor Schumacher had published and dedicated to this Society a volume of assistant tables, enabling any one, with little trouble, to reduce any single observation of the *Histoire Céleste*. Still they remained unreduced, and, therefore, useless, except on those rare occasions when, for special reasons, it might be necessary to search out and reduce any particular object.

Thus was a treasure of great value held in abeyance. This Mr. Baily perceived, and after some correspondence with the French Bureau des Longitudes, which, however, led to no result, he resolved to bring the subject before the British Association. That liberal and energetic body at once acceded to his views, and in 1838 appointed two committees, each with funds at their disposal, to execute the reductions and prepare the catalogues. The reduction and arrangement of Lacaille's stars was executed under the superintendence of Mr. Henderson, that of Lalande's under Mr. Baily, the arrangement of the work in both (if I mistake not) having been effected on a plan concerted and matured by the latter. Both works were reported as complete (the prefaces alone excepted) in 1843, and it only remained to provide for their printing. This also was done by the liberality of the British government, who assigned 1000*l.* for the purpose; and this work was especially placed under Mr. Baily's direction. These catalogues, unhappily, he did not live to see published. The printing, however, of each was found advanced at his decease as far as 8320 stars,* and is now continuing under the more immediate inspection and superintendence of Mr. Stratford.

Catalogue of the British Association.—I have yet to speak of another and a magnificent work undertaken and brought to a successful conclusion by Mr. Baily; a work which, perhaps, deserves to be considered as the greatest boon which could have been conferred on practical astronomy in its present state, and whose influence will be felt in all its ramifications, giving to them a coherence and a unity which it could hardly gain from any other source. I allude to the general standard catalogue of nearly 10,000 stars, which the British Association are about to publish, at the instance of Mr. Baily. The plan of this great and useful work is an extension of that of the Astronomical Society, of which I have already spoken. The stars (selected by Mr. Baily) form a universal system of zero-points, comprehending probably every star of the sixth and higher magnitudes in the whole heavens. All the coefficients for their reduction are tabulated, and the greatest pains bestowed upon their exact identification and synonymes in other

* The total number of stars in the two catalogues respectively, will amount to 9766, and 47,400.

catalogues; so that this, in all human probability, will become the catalogue of universal reference. It is preceded by a valuable preface from the pen of Mr. Baily, his last contribution to astronomical science.

A very important feature of this and the two catalogues last noticed is their nomenclature. The system adopted is the same in all; and *that*, a system not capriciously adopted or servilely copied, but founded on a most searching and careful revision of all existing catalogues, and of the charts of Bayer, Flamsteed, and Lacaille, rectifying the boundaries of constellations which had become strangely confused, correcting innumerable errors of naming, numbering, and lettering, and reducing, in short, to order and regularity, a subject which had become almost hopelessly entangled. The way is thus at length opened to a more rational distribution of the heavens into constellations, and that final step which must sooner or later be taken, of introducing a systematic nomenclature into sidereal astronomy, rendered easy, whensoever astronomers shall be prepared on other grounds to take it. The trouble and difficulty attending this part of the work exceeds what any one unused to such tasks can easily imagine.

There are two papers by Mr. Baily relating to sidereal astronomy, of which mention ought to be made here; viz., one "On the Proper Motions of the Stars," which was read before the Astronomical Society on the 9th December, 1831, in which a list of about 200 stars, whose proper motion appears sufficiently sensible to merit further inquiry, is discussed. In drawing up this list, he was much aided by a series of transit observations by Dr. Robinson, observed expressly with a view to this inquiry. But as no positive conclusion of a general nature is arrived at in this memoir, and as the subject is yet hardly ripe for a complete discussion, I shall dilate no further on it. The other paper to which I allude (which was read also to this Society on the 14th November, 1834,) states the result of an examination of Dr. Halley's MSS. at the Royal Observatory. The appointment of Astronomer Royal was held by Halley twenty-two years, and though for the two first of them the observatory was entirely deprived of instruments, and for the next four a five-feet transit only was available, it might, at least, have been expected that he should have used diligently the means he did possess, or, at all events, have recorded the observations he did make in a regular, methodical, and intelligible manner. From Mr. Baily's examination of these papers, however, this appears to have been very far indeed from the case; and that, with the exception of differences of right ascension between the moon and planets and neighbouring fixed stars, which alone he seems to have considered worthy of attention, little of interest could be expected to repay the trouble and expense of their reduction. Of these papers Mr. Baily, ever anxious for the preservation of records, and mindful of the dormant value which they so often possess, obtained from the Admiralty a transcript, which, being carefully

collated with, and corrected by, the original MSS., is now deposited in our library.

The mention of the Royal Observatory induces me to notice here a change which has been lately made in the constitution of that noble institution, by a revision of the royal warrant, defining the number and mode of appointment of the Visitors, and placing this Society on a similar and equal footing with the Royal Society in the discharge of that important duty. This change was made at Mr. Baily's suggestion, with the entire concurrence, however, of the then President of the Royal Society, as to its expediency, on the occasion of the demise of the crown by the death of George IV., which rendered a new warrant necessary. The new system has been found to work admirably well, and to have secured a perfect harmony of feeling between the Visitors and the eminent individual who now fills the post of Astronomer Royal, as well as entire confidence in the recommendations and suggestions of that body on the part of government. Aware, as all are now, of the fatal and soporific influence of routine in public institutions, they have only henceforward to guard against the opposite extreme; to which end, they cannot do better than take for their guide and example that admirable combination of energy, gentleness, and judgment, which distinguished Mr. Baily, no less on every public occasion than in his conduct as a Visitor, in which capacity, under both the old and the new system of visitation, he was an invariable attendant, being never absent during a period of twenty-eight years from any meeting but the last.

About the end of June, 1841, an accident happened to him which had very nearly proved fatal. Crossing Wellington Street for the purpose of taking some MSS. to a printer, a deafness, which had for some years been increasing on him, rendered him unaware of a rider recklessly urging his horse to furious speed, who either did not see him or was unable to pull up. In consequence a collision took place, and Mr. Baily received a stunning fall, accompanied with a severe scalp-wound. So violent, indeed, was the shock, that he lay for a whole week senseless, and for an equal period after his life was considered in imminent danger. His sound and excellent constitution, however, carried him through it, and no ill consequences remained. By the end of September he was enabled to resume the observations of the Cavendish experiment, which this unfortunate occurrence had interrupted, and a few weeks' residence in the country completed the cure.

On the 8th of July, 1842, he was gratified by the observation of a phenomenon which it had from his youth upwards been one of his most ardent wishes to witness, viz. a total eclipse of the sun. To this he looked forward, indeed, with a curiosity peculiarly intense; having, on the occasion of the annular eclipse of May 15, 1836, which he travelled to Scotland to observe, and which he succeeded in observing under very favourable circumstances at Jedburgh, noticed a very singular phenomenon attending the formation of the annulus. I mean the appearance of beads of light,

alternating finally with long, straight, dark threads, cutting across the narrow line of the sun's limb, which he described in a highly interesting paper read to this Society on the 9th December, 1836. On the occasion of the total eclipse he selected Pavia for his station, that town lying in the path of the centre of the shadow. There, by especial good fortune, he obtained an excellent view of it, and there he witnessed, not only a repetition of the phenomenon of the beads, but that much more astonishing and previously unheard-of one, of the flame-like, or conical rose-coloured protuberances, seen to project, as it were, from the hidden disk of the sun beyond the border of the moon. This truly wonderful appearance (which was corroborated by several other observers at different places, among others by Mr. Airy, at Turin,) was described by him, on his return from Italy, in a paper read to this Society on the 11th Nov. 1842; and it is not a little singular that the two most remarkable solar eclipses on record should thus have furnished the subjects of his first and last astronomical memoirs,—

"Servatur ad imum
Qualis ab incepto processerit."

On his return from this journey he resumed his astronomical labours on the catalogues, as we have seen, which he continued, as well as his usual unremitted attendance to the business and at the meetings of this Society, till the spring of the present year, when his health began to decline, and several weeks of serious illness, a thing utterly unknown to him at any former period of his life (except as a result of accident), gave intimation of a failing constitution. For the first time since the reorganisation of the visitation of the Royal Observatory he was unable to attend the annual meeting of the Visitors in June. He, however, rallied somewhat, so as to be able to be present at the commemoration at Oxford on July 2, on which occasion the honorary degree of Doctor of Civil Law was conferred on him by that university, as well as on Mr. Airy and Professor Struve. On his return from Oxford his health again rapidly declined, and all efforts of medical skill proving unavailing to relieve an internal complaint, which had at length declared itself, he expired, after a protracted, but happily not painful illness, during which he was fully sensible of his approaching end, in a state of the utmost calmness and composure, at half-past nine o'clock in the evening of the 30th of August, at the age of seventy years and four months.

In passing in review, as I have attempted to do, the scientific works of Mr. Baily, and noticing, as we cannot help doing, the gradual expansion of his views, aad the progressively increasing importance of the objects they embraced, we are naturally led to ask by what means he was enabled thus to live as it were two distinct lives, each so active and successful, yet so apparently incompatible with each other? how, in what is generally regarded as the decline of life, he could not only accomplish so much with such apparent ease to himself, but go on continually opening out wider

and wider plans of useful exertion in a manner which seems only to belong to the freshness of youth? The answer to such an inquiry is, no doubt, partly to be found in his uninterrupted enjoyment of health, which was so perfect that he has been heard to declare himself a stranger to every form of bodily ailment, and even to those inequalities of state which render most men at some hours of the day or night less fit for business or thought than at others. But though this is in itself a blessing of the most precious kind, and, if properly used, a vantage ground of power and success to any one favoured enough to possess it, it must be regarded in his case as subordinate to, though, no doubt, intimately connected with, a gift of a much higher order,—that of an equable and perfectly balanced intellectual and moral nature,—that greatest of gifts, which has been regarded, and justly, as the only one really worthy to be asked of Heaven in this life,—*mens sana, in corpore sano.* Few men, indeed, have ever enjoyed a state of being so habitually serene and composed, accompanied with so much power, and disposition to exert it. A calm, the reverse of apathy, a moderation having nothing in common with indifference, a *method* diametrically opposed to routine, pervaded every part of his sentiments and conduct. And hence it arose that every step which he took was measured and consequent—one fairly secured before another was put in progress. Such is ever the march of real power to durable conquest. Hence, too, it arose that a clear natural judgment, and that very uncommon gift, a sound common sense viewing all things through a medium unclouded by passion or prejudice, gave to his decisions a certainty from which few were ever found to dissent, and to his recommendations a weight which few thought it *right* to resist.

It is very difficult in speaking of Mr. Baily's character to convey a true impression through the medium of a language so exaggerative as that which men now habitually use. Its impressiveness was more felt on reflection than on the instant, for it consisted in the absence of all that was obtrusive or imposing, without the possibility of that absence being miscontrued into a deficiency,—like a sphere whose form is perfect simply because nothing is protuberant. Equal to every occasion which arose, either in public or private life, yet, when not called forth, or when others occupied the field, content to be unremarked; to speak of his conduct as unassuming would convey but a faint idea of the perfect simplicity with which he stood aside from unnecessary prominence or interference.

Hardly less inadequate would it be to say of his temper that, always equable and cheerful, it was a source of peace and happiness to himself and others. It was much more,—it was a bond of kindness and union to all around him, and infused an alacrity of spirit into every affair in which the co-operation of others was needed, which was more than a simple reflex of his own good humour. It rendered every relation between himself and others easy and natural, and brought out all the latent warmth of every

disposition. One would have been ashamed to evade a duty or refuse a burden when it was seen how lightly his share was borne, how readily he stepped out of his way to offer aid wherever he saw it needed, and how frankly every suggestion was received, and every aid from others accepted and acknowledged. This is the secret of all successful co-operation.

Order, method, and regularity, are the essence of business, and these qualities pervaded all proceedings in which he took a part, and, indeed, all his habits of life. In consequence, all details found their right place and due provision for their execution, in every matter in which he engaged. This was not so much the result of acquired habits, as a man of business, as the natural consequence of his practical views, and an emanation of that clear, collected spirit, of which even his ordinary handwriting was no uncertain index. Among hundreds of his letters which I possess, there is hardly an erasure or correction to be found, but every where, on whatever subject, or whatever the haste, the same clear, finished, copperplate characters.

Of his choice of life I have already spoken something. Fortune he regarded as a mean to an end, but that end he placed very high; and fortune, he well knew, though a mean to its attainment, was not the only or the chief mean. As a member of civilized society, to add something to civilization, to ennoble his country and improve himself, by enlarging the boundaries of knowledge, and to provide for his own dignity and happiness by a pursuit capable of conferring both,—these were the ends which he proposed and accomplished. In choosing the particular line which he did, it is impossible too highly to appreciate the self-knowledge and judgment which enabled him to see and adopt those objects best adapted to his powers, and on which they could be, on the whole, most availably and usefully employed. Both in his public and private capacity he was liberal and generous in the extreme, and both his purse and his influence were ever ready, whether to befriend merit, or to promote objects of public and, especially, of scientific utility.

To term Mr. Baily a man of brilliant genius or great invention, would in effect be doing him wrong. His talents *were* great, but rather solid and sober than brilliant, and such as seized their subject rather with a tenacious grasp than with a sudden pounce. His mind, though, perhaps, not excursive, was yet always in progress, and by industry, activity, and using to advantage every ray of light as it broke in upon his path, he often accomplished what is denied to the desultory efforts of more imaginative men. Whatever he knew he knew thoroughly, and enlarged his frontier by continually stepping across the boundary and making good a new and well-marked line between the cultivation within and the wilderness without. But the frame of his mind, if not colossal, was manly in the largest sense. Far-sighted, clear-judging, and active; true, sterling, and equally unbiassed by partiality and by fear; upright, undeviating, and candid, ardently attached to truth, and

deeming no sacrifice too great for its attainment;—these are qualities which throw what is called genius, when unaccompanied, or but partially accompanied, with them, quite into the shade.

In speaking of his conduct with respect to this Society, and the infinite obligations we owe to him, we must regard him in the first place as the individual to whom, more than to any other, we owe the titles of a parent and a protector, and our early consolidation into a compact, united, and efficient body. As Secretary *pro tempore*, the draft of our Rules and the first Address explanatory of our objects, circulated at the commencement of our existence, were entirely, or in great measure, prepared by him; and, governed by these rules with hardly any change, we have continued to flourish for twenty-four years, which is the best test of their adaptation to our purposes. As I have already stated, he acted as Secretary during the first three years of our existence, during which period the business of our meetings and of our council was brought into that systematic and orderly train of which the benefit has never since ceased to be felt. On retiring from this office he was elected Vice-President, and on the next biennial demise of the chair he became our President, an office which he afterwards filled for three subsequent periods of two years, including that of his lamented death. Altogether, during eight years as President and eleven as Vice-President, he filled the highest offices of our institution, and was never off the Council, nor was there any Committee on which he did not sit as one of its most active and efficient members.

With the exception of the Meeting of May 12, 1836, when he was in Scotland observing the annular eclipse, he was never absent from any Council, or from any Ordinary, General, or Committee Meeting, until finally prevented by illness. Nor during the whole period of the Society's existence was there any matter in which its interests were concerned in which he was not a mover, and, indeed, the principal mover and operator. Nor was this care of our interests and respectability confined to formal business or to matters of internal management. On every external occasion which offered he bore those interests in mind. He watched and seized the precise opportunity to procure for us from Government the commodious apartments we occupy. He obtained for us the respected and dignified position of Joint-Visitors of the Royal Observatory. He let no opportunity pass of enriching our library with attested copies of the most valuable astronomical documents, such as "Flamsteed's Letters" and "Halley's Recorded Observations." He husbanded and nursed our finances with the utmost judgment and economy, thereby rendering us rich and independent. He printed at his own cost the thirteenth volume of our *Transactions*, and procured to be defrayed by Government the expense of the seventh, and, by subscription among the members, without entrenching on the funds of the Society, that of the computation and printing of our Catalogue. He prepared all our Annual Reports, and his addresses from the chair will always be read with pleasure

and instruction. He also prepared all Committees' Reports, and translated for reading at our meetings numerous notices and communications in the German language: among others the memoir relating to the Berlin charts. In fine, he superintended every thing in every department. But it was the manner and delicate tact of this superintendence which gave it its value and rendered it efficient. In respect of this point I may, perhaps, be permitted to use the expressions of a distinguished member of our body, to whom we owe many and great obligations, and who has witnessed the working of its machinery from the beginning, an advantage of which for some years I have myself been deprived by non-residence in London and absence from England. "Of his management of our Society," says Mr. Sheepshanks, "it is difficult to speak so as to convey a correct idea. No assumption, no interference with other people, no martinet spirit (which seems almost natural to all good business men), but every thing carried on smoothly and correctly, and without bustle. He hit, better than any chairman I have ever seen, the mean between strictness and laxity, and, while he kept every thing going in its proper channel, he also kept every body in good humour. This natural tact was a great gift, but there was another quality which I never saw in any one but him, and that was his readiness to give precedence and room to every one who wished to do any thing useful, and his equal readiness to supply every deficiency and do the work of every body else. He was also the person who never was asleep and never forgot any thing, and who contrived by his good humour, hospitality, and good sense, to keep every thing in train." To much of this view, as a matter of general character, I have given my own independent expression, but I could not deny myself the satisfaction of corroborating my own judgment by that of one so well qualified, from intimate knowledge, to form opinions.

Mr. Baily, as I have already stated, was a member of the Royal, Geological, and Linnean Societies, to which I may also add the Royal Irish Academy and the Society of Civil Engineers. In the Royal Society his eminence as an astronomer and a man of general science made his presence valuable, and the universal respect in which he was held gave him much influence. He filled in that body the office of Vice-President for six years, of Treasurer for three, and was fifteen times elected on the Council. I have already mentioned two of the three papers he contributed to its *Transactions*. The third contains a minute account of the standard barometer of that society, fixed up in their apartments in the year 1837, in which he enters into every particular of its construction, mode of registry, and corrections. It was read on the 16th of November, 1837. He was also one of the earliest members of the Royal Geographical Society, and took a very active part in its establishment. He was also a member and one of the trustees of the British Association, at whose meetings he was an occasional attendant, and acted, as we have seen, on some important committees. In 1835, the University of Dublin conferred on him

the honorary title of Doctor of Civil Law, as, I have already stated, was also done by Oxford in 1844. Among the foreign Academies, which in honouring him honoured themselves, I find him to have been a correspondent of the Royal Institute of Sciences of Paris, and of the Royal Academies of Berlin, Naples, and Palermo, as well as the American Academy of Arts and Sciences at Boston.

His portrait by Phillips, presented by some Fellows of the Society, has long adorned, and, though for the present removed from its frame, will speedily again adorn our meeting-room. May his mantle descend on our future presidents, and his spirit long continue to preside over our councils and animate our exertions in the cause he had so much at heart!

On the conclusion of the reading of the preceding Memoir, the thanks of the Society were proposed by the Dean of Ely, and unanimously voted to Sir John Herschel.

It was then moved by Mr. De Morgan, seconded by Mr. Donkin, and unanimously resolved,

> "That the Society feels it impossible to express in adequate terms its obligations to its late President; and it desires to impress on the minds of all the Fellows, that such imitation of his example as their occupations will allow is the mode of testifying their gratitude and respect for his memory with which he would have been most pleased."

LIST OF MR. FRANCIS BAILY'S PUBLICATIONS.

Chronologically Arranged.

1. Tables for the Purchasing and Renewing of Leases for Terms of Years certain and for Lives, with Rules for determining the Value of the Reversion of Estates after any such Leases, and for the Solution of other useful Problems, adapted to general use; to which is added an Appendix. London, 1802. 8vo.
   Second Edition, 1807.
   Third Edition, 1812.
2. The Rights of the Stock-Brokers defended against the attacks of the City of London. London, 1806. 8vo.
3. The Doctrine of Interest and Annuities analytically investigated and explained, together with several useful Tables connected with the Subject. London, 1808. 4to.

4. An Account of the several Life-Assurance Companies established in London, containing a View of their respective merits and advantages. London, 1810. 8vo.
   Second Edition, 1811.

5. The Doctrine of Life-Annuities and Assurances analytically investigated and practically explained, together with several useful Tables connected with the subject. London, 1810. 8vo.

   (This work has been lately translated and published in France under the following title: —
   "Théorie des Annuités viagères et des Assurances sur la Vié, suivie d'une Collection de Tables relative à ces matières, par Francis Baily. Traduit de l'Anglais par Alfred de Courcy, et publié par la Compagnie d'Assurances générales sur la Vie. Paris, 1836.")

6. On the Solar Eclipse which is said to have been predicted by Thales. Read before the Royal Society, March 14, 1811. *Phil. Trans.* 1811.

7. A Synopsis of the Principal Elements of Astronomy, deduced from M. Laplace's *Exposition du Systême du Monde.* London, 1812. 8vo.

8. A New Chart of History. Large Sheet. London, 1812.
   Corrected to 1817, with the Third Edition of the following work.

9. Description and Use of a New Chart of History, exhibiting the most material Revolutions that have taken place in the principal Empires, Kingdoms, and States, from the earliest authentic Records to the commencement of the present Year. London, 1812, 8vo.
   Second Edition, 1813.
   Third Edition, 1817.

10. An Appendix to the Doctrine of Life-Annuities and Assurances, containing a Paper read before the Royal Society, on a New Method of Calculating the Value of Life Annuities. London 1813. 8vo.

(By this Appendix the Doctrine of Life-Annuities, &c. was divided into 2 vols.)

11. An Epitome of Universal History, Ancient and Modern, from the earliest authentic Records to the commencement of the present Year. London, 1813. 2 vols. 8vo.

12. Report of the Sub-Committee of the Stock-Exchange relative to the late Fraud. London, 1814. 8vo.
    Second Report of the Sub-Committee of the Stock Exchange relative to the late Fraud. London, 1815. 8vo.

13. Report of the Committee of the Stock-Exchange appointed for the Distribution of the Money stopped on Account of the late Fraud. London, 1815. 8vo.

14. Memoir relative to the Annular Eclipse of the Sun, which will happen on September 7, 1820. London, 1818. 8vo. with a map.
(Not published for sale.)

15. On the *Nautical Almanac*. *Phil. Mag.* for April, 1819. Vol. LIII. p. 217.

16. Memoir on a New and Certain Method of Ascertaining the Figure of the Earth by means of Occultations of the Fixed Stars. By A. Cagnoli, with Notes and an Appendix. London, 1819. 8vo.
(Not published for sale.)

17. Address Explanatory of the Views and Objects of the Astronomical Society. London, 1820. 8vo.
(Also nearly the whole of the Society's Annual Reports till the year 1844, inclusive.)

18. On a Method of Fixing a Transit Instrument exactly in the Meridian. Read June 9, 1820. *Mem. Ast. Soc.* Vol. I. p. 59.

19. On the Apparent Place of the Pole Star at the time of its upper culmination for the years 1820, 1821, and 1822. *Phil. Mag.* 1820. Vol. LV. p. 401.

20. Tables by the Board of Longitude. *Phil. Mag.* 1820. Vol. LVI. p. 288.

21. On the Solar Eclipse which took place on Sept. 20, 1820. Read Dec. 8, 1820. *Mem. Ast. Soc.* Vol. I. p. 135.

22. Astronomical Tables and Remarks for the Year 1822. With a Map. London, 1822. 8vo.
(Not published for sale.)

23. Remarks on the present defective state of the *Nautical Almanac*. London, 1822. 8vo.

24. On a New Method of determining the Latitude of a Place by Observations of the Pole Star. *Phil. Mag.* 1822. Vol. LIX. p. 445.

25. Astronomical Information. *Phil. Mag.* 1822. Vol. LX. p. 388.

26. On some New Tables of Aberration and Nutation. *Phil. Mag.* 1822. Vol. LX. p. 279.

27. On some New Tables for determining the Time by means of Altitudes taken near the Prime Vertical. Read January 10, 1823. *Mem. Ast. Soc.* Vol. I. p. 315.

28. Mr. Pond and M. Bessel. *Phil. Mag.* 1823. Vol. LXII. p. 389.

29. Supplementary Table for computing the Precession and Nutation of the Fixed Stars. *Phil. Mag.* 1823. Vol. LXI. p. 217.

30. On the New Tables of Aberration, Nutation, and Precession. *Phil. Mag.* 1823. Vol. LXI. p. 366.

31. Astronomical Information. Mr. Pond and M. Bessel. *Phil. Mag.* 1823. Vol. LXI. p. 469.

32. On M. Inghirami's List of Occultations of the Fixed Stars. *Phil. Mag.* 1823. Vol. LXII. p. 161.

33. Astronomical Information. *Phil. Mag.* 1823. Vol. LXII. pp. 391 and 466.

34. Mr. Pond and M. Bessel. *Phil. Mag.* 1823. Vol. LXII. pp. 390 and 467.

35. On the Mercurial Compensation-Pendulum. Read May 9 and June 13, 1823. *Mem. Ast. Soc.* Vol. I. pp. 381–420, with a Plate.

36. On the ensuing Opposition of Mars. *Phil. Mag.* 1824. Vol. LXIII. p. 50.

37. On the Circular Micrometer. *Phil. Mag.* 1824. Vol. LXIII. p. 167.

38. On Mr. Babbage's New Machine for Calculating and Printing Mathematical and Astronomical Tables. *Phil. Mag.* May 1824. Vol. LXIII. p. 335; and *Ast. Nach.* No. 46.

39. On the Occultation of the *Georgium Sidus*. *Phil. Mag.* 1824. Vol. LXIII. p. 458.

40. Astronomical Discovery (Bessel). *Phil. Mag.* 1824. Vol. LXIV. p. 67.

41. New Lunar Tables by M. Damoiseau. *Phil. Mag.* 1824. Vol. LXIV. p. 68.

42. On the Method of determining the Difference of Meridians by the Culmination of the Moon and Stars; with an Appendix and a List of Stars applicable to the purpose for the Year 1825, Read April 9 and May 14, 1824. *Mem. Ast. Soc.* Vol. II. p. 1.

43. A Statement of some circumstances connected with the mode of contracting the Columbian Loan in 1824. London, 1825. 8vo.

44. Astronomical Information. *Phil. Mag.* 1825. Vol. LXV. p. 466.

45. Errors in Piazzi's Catalogue of Stars. *Phil. Mag.* 1825. Vol. LXVI. p. 261.

46. Notice respecting the opposition of *Mars*. *Phil. Mag.* 1825. Vol. LXVI. p. 465.

47. An Address delivered at a Special General Meeting of the Astronomical Society of London, on April 14, 1826, on presenting the Gold Medals to J. F. W. Herschel, Esq., J. South, Esq., and Professor Struve, *Mem. Ast. Soc.* Vol. II. p. 541.

48. Astronomical Tables and Formulæ, together with a variety of Problems explanatory of their use and application. To which are prefixed the Elements of the Solar System. London, 1827. 8vo.

49. A List of Moon-culminating Stars for 1827. *Phil. Mag.* Vol. I. (second series), p. 47.

50. Astronomical Collections, No. 1, containing a Catalogue of Zodiacal Stars. London, March 1827. 8vo.
(Not published for sale.)

51. New Tables for facilitating the Computation of Precession, Aberration, and Nutation of 2881 principal Fixed Stars; together with a Catalogue of the same reduced to Jan. 1, 1830. To which is prefixed an Introduction explanatory of their construction and application. London, 1827.
Appendix to Vol. II. *Mem. Ast. Soc.*

52. Further list of Errors in Piazzi's Catalogue of Stars. *Phil. Mag.* 1827. Vol. I. p. 19.

53. List of Moon-culminating Stars for 1827. *Phil. Mag.* for 1827. Vol. I. (new series) p. 47.

54. On some new Auxiliary Tables for determining the Apparent Places of the Greenwich Stars. *Phil. Mag.* for 1827. Vol. I. p. 81.

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59. Further Remarks on the present defective state of the *Nautical Almanac*; to which is added an Account of the new Astronomical Ephemeris published at Berlin. London, Jan. 1829. 8vo.
(Extracted from the Appendix to "Astronomical Tables and Formulæ.")

60. A Letter to the Editor of "The Times," and inserted in that paper April 17, 1829.

61. On the Discordances in the Results of the Methods for Determining the Length of the Simple Pendulum. *Phil. Mag.* 1829. Vol. V. p. 97.

62. Appendix to Lieut. H. Foster's Paper on the Longitude of Port Bowen, by the method of Moon-culminating Stars. London, 1829. *Mem. Ast. Soc.* Vol. III. p. 43.

63. A Catalogue of the Positions (in 1690) of 564 Stars observed by Flamsteed, but not inserted in his British Catalogue; together with some remarks on Flamsteed's Observations. Read May 8, 1829. *Mem. Ast. Soc.* Vol. IV. pp. 129–164.

64. On the System of Prize Chronometers at Greenwich. *Phil. Mag.* 1829. Vol. VI. p. 424.

65. On Mr. Pond's recent Catalogue of the Places of 720 principal Stars, compared with the Places of the same Stars in the Catalogue of this Society; with Remarks on the Differences between the two Catalogues. Read March 12, 1830. *Mem. Ast. Soc.* Vol. IV. pp. 255–290.

66. Mayer's Catalogue of Stars, corrected and enlarged; together with a comparison of the Places of the greater part of them, with those given by Bradley, and a reference to every Observation of every Star. Read June 11, 1830. *Mem. Ast. Soc.* Vol. IV. pp. 391–445.

67. Report of the Committee of the Astronomical Society of London relative to the Improvement of the *Nautical Almanac*. Adopted by the Council, November 19, 1830: approved by the Right Honourable Lords Commissioners of the Admiralty, and ordered by them to be carried into effect. *Mem. Ast. Soc.* Vol. IV. p. 447.

68. On the New *Nautical Almanac*. *Phil. Mag.* 1831. Vol. IX. p. 23.

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74. An Account of Experiments with an Invariable Pendulum, during a Russian Scientific Voyage by Captain Luetke. *Phil. Mag.* 1832. Vol. I. p. 420.

75. An Address delivered at the Annual General Meeting of the Royal Astronomical Society, on Feb. 8, 1833, on presenting the Honorary Medal to Professor Airy. *Mem. Ast. Soc.* Vol. VI. pp. 247–256.

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80. Report on the New Standard Scale of this Society. Presented December 11, 1835. *Mem. Ast. Soc.* Vol. IX. p. 35.

81. On a Remarkable Phenomenon that occurs in Total and Annular Eclipses of the Sun. Read Dec. 9, 1836. *Mem. Ast. Soc.* Vol. X. p. 1.

82. Supplement to the Account of the Rev. John Flamsteed. London, 1837. 4to.
(Printed at his own expense for private circulation only.)

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84. On the Non-existence of the star 42 *Virginis*.
Monthly Notices of the Roy. Ast. Soc. June 9, 1837.

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86. Description of a New Barometer, recently fixed up in the Apartments of the Royal Society; with Remarks on the mode hitherto pursued at various periods, and an Account of that which is now adopted for correcting the observed Height of the Mercury in the Society's Barometers. *Phil. Trans.* 1837. p. 431.

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88. Experiments with the Torsion-Rod for Determining the Mean Density of the Earth. *Mem. Ast. Soc.* Vol. XIV.
(Printed partly at the Government expense.)

89. The Catalogues of Ptolemy, Ulugh Beigh, Tycho Brahé, Halley, Hevelius, deduced from the best Authorities; with various Notes and Corrections, and a Preface to each Catalogue. To which is added the synonym of each Star in the Catalogues of Flamsteed or La Caille, as far as the same can be ascertained. Forming Vol. XIII. of *Mem. Ast. Soc.*
(Printed at his own expense.)

90. Some Remarks on the Total Eclipse of the Sun, on July 8, 1842. *Mem. Ast. Soc.* Vol. XV. p. 1.

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